DOCKET NO.: 220408US2X

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:
Tetsuya KAWANISHI, et al

SERIAL NO.: 10/092,628

FILED: March 8, 2002

FOR: REASONANCE TYPE OPTICAL MODULATOR USING SYMMETRIC…

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

PRELIMINARY AMENDMENT

SIR:

Prior to examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION

Please amend the paragraph [0032] with the following text:

Figure 9A is a plan view of a modulator in which the modulation electrode is an asymmetric ICPW (Interdigital Coplanar Waveguide).

Please amend the paragraph [0033] with the following text:

Figure 9B is a cross-sectional view of the modulator in which the modulation electrode is an asymmetric ICPW (Interdigital Coplanar Waveguide).

Please amend the paragraph [0039] with the following text:

Figure 14A is a plan view of a resonance type optical modulator in which the modulation electrode is composed of an open stub 1 and an open stub 5 on the optical waveguide.

Please amend the paragraph [0040] with the following text:

Figure 14B is a cross-sectional view of the resonance type optical modulator in which the modulation electrode is composed of the open stub 1 and open stub 5 on the optical waveguide.

Please amend the paragraph [0041] with the following text:

Figure 15 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of an electric signal on the modulating electrode in an optical waveguide composed of the open stubs 1 and 5, shown with respect to the coordinate system moving along with the light wave propagating in the waveguide.

Please amend the paragraph [0042] with the following text:

Figure 16 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of an electric signal in the modulating electrode in an optical waveguide composed of the open stubs 1 and 5, in a non-optimized case, shown with respect to the coordinate system moving along with the light wave propagating in the waveguide.

Please amend the paragraph [0055] with the following text:

Both ends of modulation electrode 1 are connected to the common electrode. The modulation electrode is 5 pm wide and 7010 pm long, and is separated from the common electrodes 6 and 7 by a distance of 27 pm. The electrode length is set to be 0.41 times the wavelength of the microwave modulation signal, and can be set to be from 0.41 to 0.44 (or 0.91 to 0.94) times the wavelength. To ensure that the combined impedance of stub and electrode stays in an appropriate region, the modulation electrode 1should have a

length that is 15 to 20% offset on the shorter wavelength side relative to the resonance point of the microwave signal.

Please amend the paragraph [0072] with the following text:

Figure 15 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of a lightwave propagating in a waveguide along the modulation electrode of a thus-configured Mach-Zehnder interferometer type resonance type optical modulator used for intensitiy-modulating a light wave having a wavelength of 1.55 microns with a microwave signal having a center frequency of 10 GHz, shown with respect to the coordinate system moving along with the light wave propagating in the waveguide. The field strength is shown as the normalized amplitude of the input microwave signal. A comparison with the Figure 12 result obtained using no stub shows higher field strength. Also, with respect to the coordinate system moving along with the light wave propagating in the waveguide, there is a phase increase from left to right. At a distance of 427 pm from the junction between the open stubs 1 and 5, that is, at a distance that is 0.05 times the wavelength, the phase exceeds 180 degrees, showing that at that portion, the phase change effect of the input microwave electrical signal (the induced phase amount) is reversed.

Please amend the paragraph [0076] with the following text:

As described, the modulation electrode is comprised of a short stub 8 and a short stub 4 on the same optical waveguide. The short stub 8 is 5 pm wide and 1710 pm long (including half the width of the wiring line), and is separated from common electrode 7 by a distance 27 pm. This stub length is 0.45 times the wavelength of the microwave modulation signal propagating on the waveguide, and can be set to 0.43 to 0.47 (or 0.92

to 0.95) times the wavelength. The short stub 4 is 5 pm wide and 256 pm long (including half the width of the wiring line), and is separated from common electrode 7 by a distance of 27 pm. The stub length is 0.03 times the wavelength of the microwave modulation signal propagating on the waveguide. As shown in Figure 17, the electrical feed takes place at the junction between the two stubs. A 100-pm feeding line connection is provided between the junction and a tapered transformer. There is no essential reason to provide this wiring line, which can be omitted. The tapered transformer is to ensure that the incoming signal from the input end of the coplanar waveguide is supplied to the stubs without being reflected back. The tapered transformer is 800 pm long ant tapers from a width of 100 pm to a width of 35 pm, with the distance from the common electrode tapering from 325 pm to 107.5 pm.

SUPPORT FOR THE AMENDMENT

The amendments to the specification correct typographical errors. No new matter is believed to be added by entry of this amendment. Favorable consideration of this application, as presently amended, is respectfully requested.

Respectfully submitted,

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Marked-Up Copy
Serial No: 10/10/092,628
Preliminary Amendment Filed:
6-25-02

IN THE SPECIFICATION

Please amend the paragraph [0032] with the following text:

Figure [9] 9A is a plan view of a modulator in which the modulation electrode is an asymmetric ICPW (Interdigital Coplanar Waveguide).

Please amend the paragraph [0033] with the following text:

Figure [9] 9B is a cross-sectional view of the modulator in which the modulation electrode is an asymmetric ICPW (Interdigital Coplanar Waveguide).

Please amend the paragraph [0039] with the following text:

Figure 14A is a plan view of a resonance type optical modulator in which the modulation electrode is composed of an open stub 1 and an open stub [2] 5 on the optical waveguide.

Please amend the paragraph [0040] with the following text:

Figure 14B is a cross-sectional view of the resonance type optical modulator in which the modulation electrode is composed of the open stub 1 and open stub [2] 5 on the optical waveguide.

Please amend the paragraph [0041] with the following text:

Figure 15 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of an electric signal on the modulating electrode in an

optical waveguide composed of the open stubs 1 and [2] 5, shown with respect to the coordinate system moving along with the light wave propagating in the waveguide.

Please amend the paragraph [0042] with the following text:

Figure 16 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of an electric signal in the modulating electrode in an optical waveguide composed of the open stubs 1 and [2] 5, in a non-optimized case, shown with respect to the coordinate system moving along with the light wave propagating in the waveguide.

Please amend the paragraph [0055] with the following text:

Both ends of modulation electrode [8] 1 are connected to the common electrode. The modulation electrode is 5 pm wide and 7010 pm long, and is separated from the common electrodes 6 and 7 by a distance of 27 pm. The electrode length is set to be 0.41 times the wavelength of the microwave modulation signal, and can be set to be from 0.41 to 0.44 (or 0.91 to 0.94) times the wavelength. To ensure that the combined impedance of stub and electrode stays in an appropriate region, the modulation electrode [8] 1 should have a length that is 15 to 20% offset on the shorter wavelength side relative to the resonance point of the microwave signal.

Please amend the paragraph [0072] with the following text:

Figure 15 shows the result of a computer simulation relating to the field strength (solid line) and phase (dotted line) of a lightwave propagating in a waveguide along the modulation electrode of a thus-configured Mach-Zehnder interferometer type resonance type optical modulator used for intensitiy-modulating a light wave having a wavelength of 1.55 microns with a microwave signal having a center frequency of 10 GHz, shown

with respect to the coordinate system moving along with the light wave propagating in the waveguide. The field strength is shown as the normalized amplitude of the input microwave signal. A comparison with the Figure [3] 12 result obtained using no stub shows higher field strength. Also, with respect to the coordinate system moving along with the light wave propagating in the waveguide, there is a phase increase from left to right. At a distance of 427 pm from the junction between the open stubs 1 and 5, that is, at a distance that is 0.05 times the wavelength, the phase exceeds 180 degrees, showing that at that portion, the phase change effect of the input microwave electrical signal (the induced phase amount) is reversed.

Please amend the paragraph [0076] with the following text:

As described, the modulation electrode is comprised of a short stub [1] 8 and a short stub [2] 4 on the same optical waveguide. The short stub [1] 8 is 5 pm wide and 1710 pm long (including half the width of the wiring line), and is separated from common electrode 7 by a distance 27 pm. This stub length is 0.45 times the wavelength of the microwave modulation signal propagating on the waveguide, and can be set to 0.43 to 0.47 (or 0.92 to 0.95) times the wavelength. The short stub [2] 4 is 5 pm wide and 256 pm long (including half the width of the wiring line), and is separated from common electrode 7 by a distance of 27 pm. The stub length is 0.03 times the wavelength of the microwave modulation signal propagating on the waveguide. As shown in Figure 17, the electrical feed takes place at the junction between the two stubs. A 100-pm feeding line connection is provided between the junction and a tapered transformer. There is no essential reason to provide this wiring line, which can be omitted. The tapered transformer is to ensure that the incoming signal from the input end of the coplanar

waveguide is supplied to the stubs without being reflected back. The tapered transformer is 800 pm long ant tapers from a width of 100 pm to a width of 35 pm, with the distance from the common electrode tapering from 325 pm to 107.5 pm.